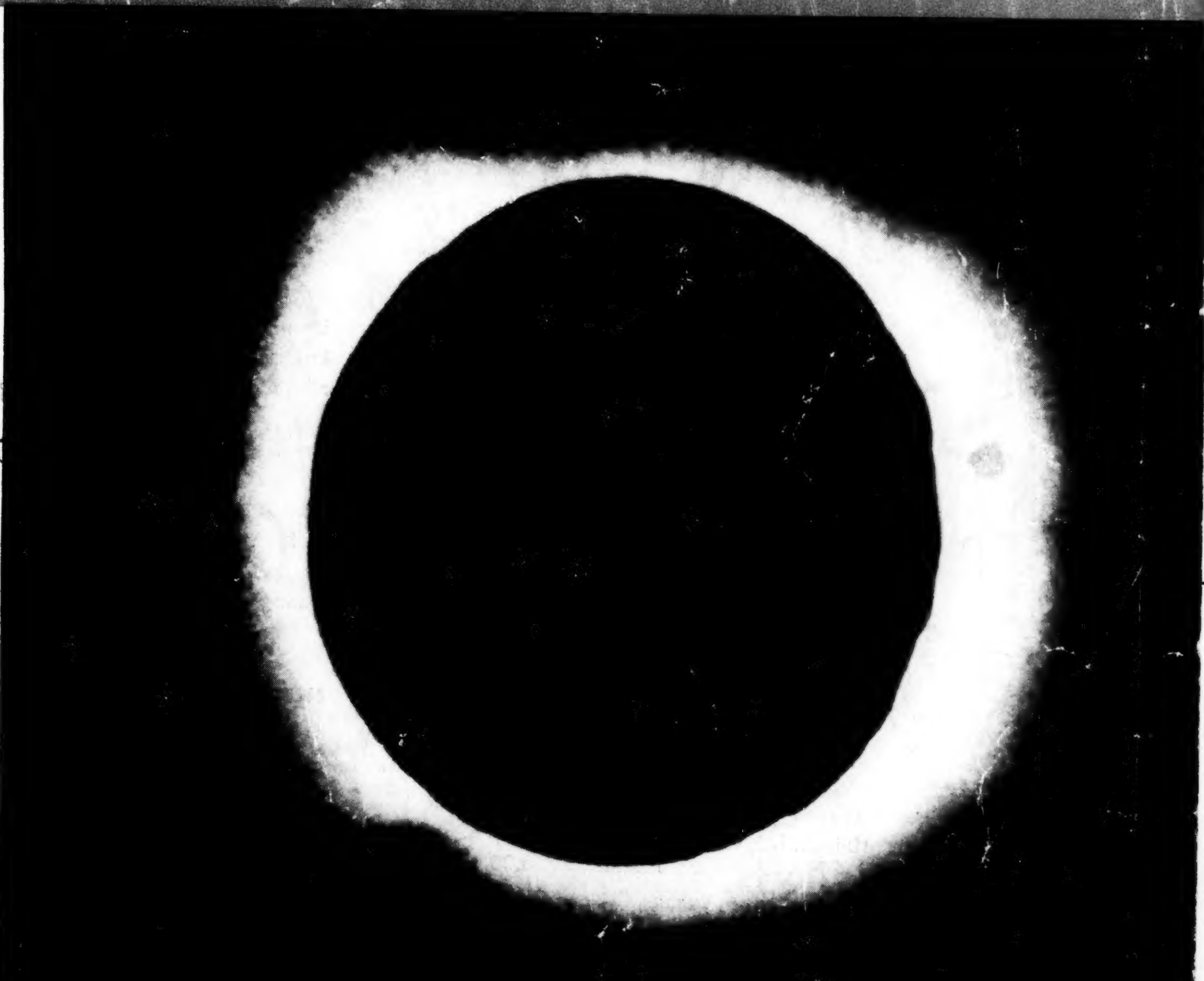
THE MONTHLY EVENING SKY MAP

The Stars Brought Down To Earth

VOL. LIV NO. 503

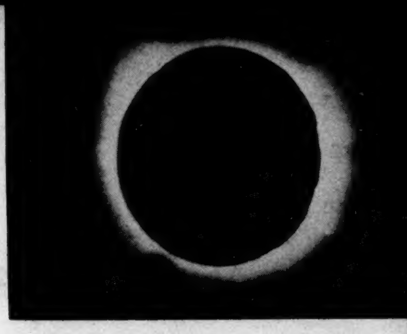


FIFTY CENTS

JANUARY · FEBRUARY 1960

FOUNDED IN 1905 BY
LEON BARRITT

THE MONTHLY EVENING SKY MAP



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THE MONTHLY EVENING SKY MAP

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The cover photograph was reproduced from one of the orignal full-color prints of the Oct. 2, 1959, total eclipse of the sun taken by the combined McDonnell Aircraft Corp.-USAF Air Research and Development Command eclipse expedition to the Canary Islands and released for publication through their courtesy. Conspicuous is the absence of the solar corona's equatorial extensions usually associated with eclipses occurring at sunspot minimum (the sun just passed sunspot maximum). Note the interesting notch at lower left and the evidence of Baily's beads on the limb at right. McDonnell-USAF Photo.

"She Loved The Stars . . ."

Seldom in the history of popular astronomy has one person made so significant a mark on the future as did Miss Charlie M. Noble, who died in Fort Worth, Texas, late in November. She was 82.

During many decades this venerable youth leader attracted and aided thousands of young people, developed their astronomical interests and skills with scientific thoroughness, devised new techniques of stimulation, and developed methods for basic education in astronomy which have been used as a pattern all over the country.

Charlie Noble was gentle and unpretentious, but her activities were bold, imaginative and forceful. In achieving her goal of encouraging a sound, scientific attitude toward the learning of astronomy, she gained world recognition for herself and for Fort Worth. Thousands of young, very young and not-so-young persons have been influenced by the astronomical teaching systems Miss Noble envisioned.

Legend galore has grown up about her. Some of the young people she had worked with recently were *grandchildren* of those she introduced to astronomy decades ago. During her illness, her doctors in the hospital were former students.

Her first inspection of the small planetarium to be installed in the new Fort Worth Children's Museum was in the bathroom of a local hotel—the only light-tight room available. She first learned that the new Fort Worth planetarium was in her honor came when she unveiled the bronze plaque which bore her name.

Whether the tens of thousands of her admirers became astronomers and scientists or went into wholly unrelated fields, there has been, because of her, a notable upsurge of popular interest in astronomy that can be definitely traced to her. Three years ago she was presented with the Astronomical League award for her contributions to the popularization of astronomy.

Although she was almost sightless for the past year, Miss Noble's quiet energy recently resulted in the issuance of a new publication, *Texas Skies*, which, it is hoped, will be continued as a memorial to her, together with the other astronomical programs of the Fort Worth Children's Museum.

Miss Charlie Noble launched well; her love for children and astronomy was translated into a program which is already a living testimony to her good works.

—A.N.S.

From "Nebula" to "Galaxy"

. . . the Greeks had a word for it —

PATRICK V. RIZZO

ASTRONOMICALLY speaking, the word "galaxy" has had a very interesting history. It is the term most usually employed for those exterior galactic systems which are the foundation of modern cosmological science. It has successfully competed with such expressions as extragalactic nebula, island universe, nebula, external galaxy, Milky Way, spiral nebula, anagalactic nebula, non-galactic nebula, external system, external universe, exterior system and others.

A brief glance at the astronomical writings of little more than a decade ago, will show the great stride that the term "galaxy" has made since then. Those articles and books written at that time, which used such expressions as external universe, non-galactic nebula, and island universe, today seem to have a nostalgic air about them; while paradoxically, the following excerpt, because it uses the term "galaxy" with its modern connotation, seems as though it might have just been written:

"At length Sirius and all the brotherhood of our constellations and the galaxy of our heavens stood far below at our feet as a little nebula amongst other yet more distant nebulae. Thus we flew on through the starry wildernesses: one heaven after another unfurled its immeasurable banners before us, and then rolled up behind us; galaxy behind galaxy towered up into solemn altitudes before which the spirit shuddered."

This piece of "science fiction" appeared in the March, 1824, issue of the *London Magazine*. It is part of Thomas De Quincey's free translation of Jean Paul Richter's "Dream Upon The Universe." The plural of "galaxy" appeared also in this article in the following quaint form:

"According to Herschel, the most remote of the galaxies which the telescope discovers lie at such a distance from us that their light, which reaches us at this day, must have set out on its journey two millions of years ago; and thus by optical laws it is possible that whole squadrons of the starry hosts may be now reaching us with their beams which have themselves perished ages ago."

As is well known, the need for a descriptive term for these objects started with Thomas Wright, who in 1750, in his *An Original Theory Or New Hypothesis of the Universe*, gave us the first hint of this modern conception of the universe. He called the galaxies by the term "external creations." That a "Plenum of Creations not unlike the Known universe may be the real case," he stated, "is in some degree made evident by the many cloudy spots, just perceivable by us, as far without our starry regions in which through visibly luminous spaces, no one star or particular constituent can possibly be distinguished; those in all likelihood may be external creations, bordering upon the known one, too remote for even our telescopes to reach."

Shortly afterwards, in 1755, Immanuel Kant published his *Universal Natural History and Theory of the Heavens*. He, of course, wrote in German. He referred to them as nebulae, milky ways, star systems and universes. Note how modern his ideas seem in these excerpts from that work translated by W. Hastie in "Kant's Cosmogony" (1900):

"Their analogy [the nebulae] with the stellar system in which we find ourselves, their shape, which is just what it ought to be according to our theory, the feebleness of their light which demands a presupposed infinite distance: All this is in perfect harmony with the view that these elliptical figures are just universes and, so to speak, Milky Ways. . ."

The 72-inch Leviathan of Lord Rosse, constructed during the mid-19th century. With this instrument, Rosse first demonstrated the spiral nature of galaxies (see page 6).

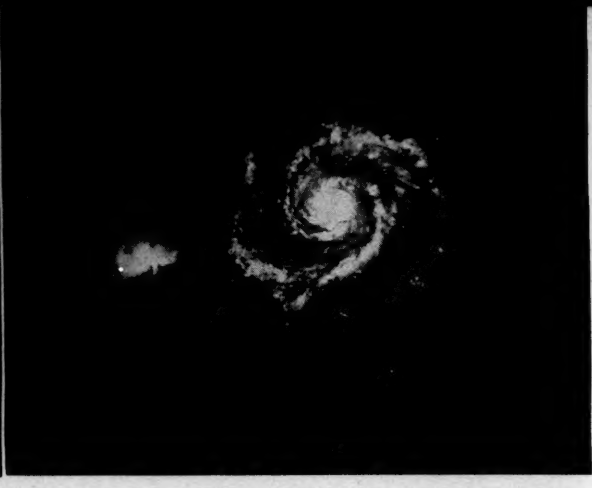
"If the grandeur of a planetary world in which the earth, as a grain of sand, is scarcely perceived, fills the understanding with wonder, with what astonishment are we transported when we behold the infinite multitudes of worlds and systems which fill the extension of the Milky Way! But how is this astonishment increased, when we become aware of the fact that all these immense orders of star-worlds again form but one of a number whose termination we do not know, and which perhaps, like the former, is a system inconceivably vast—and yet again but one member in a new combination of numbers!" Johann Lambert, writing in 1761, in his "Cosmological Letters," although his concept differs somewhat from the modern one, also called them "Milky Ways." These perceptions of Kant and Lambert anticipated later observational proofs by more than 150 years.

Sir William Herschel later spoke of them as nebulae, Milky Ways, stellar systems and universes. His ideas of the universe underwent some changes, but in one of his earlier statements he said, "the stupendous sidereal system we inhabit, consisting of many millions of stars, is, in all probability, a detached nebula.

(Continued on Page 6)

The Andromeda galaxy (Messier 31), the closest neighbor to our own Milky Way galaxy, has long been the target of astronomers' galactic explorations. Obscuring matter in its spiral arms still hides many of this great spiral's secrets.

—Lick Observatory Photograph

(Left) A drawing by Lord Rosse of Messier 51 in Canes Venatici, from a plate in Mitchel's "Planetary and Stellar Worlds." Compare this to 200-inch photograph (right) of same object. Neighboring galaxy at left is NGC 5195. (Mt. Wilson and Palomar Observatories).

Among the great number of nebulae which I have now already seen, amounting to more than 900, there are many which in all probability are equally extensive with that which we inhabit."

On December 30, 1786, English novelist Fanny Burney visited Herschel with her father and she recorded in her diary, "Already with that [telescope] he has now in use, he has discovered fifteen-hundred universes." And again she writes in another place, "Mr. Herschel then showed me some of his new discovered universes . . ." Because of Herschel's many investigations into the construction of the heavens, his great fame, and his picturesque language, later writers have improperly credited him with the origin of several terms for this concept.

These astronomical ideas soon fired the imagination of the poets and other writers. We have seen that by 1824, in the De Quincey article, the word "galaxy" was no longer restricted to our own Milky Way. Other galaxies are mentioned, separated by enormous distances from ours. De Quincey, a popular writer whose articles were reprinted many times without the benefit of copyright, in turn influenced the nomenclature of many astronomers. He was acquainted with Dr. J. P. Nichol, professor of astronomy at the University of Glasgow and author of *Views of the Architecture of the Heavens* (1838) and *Thoughts on Some Important Points Relating to the System of the World* (1846). Dr. Nichol had first used the term "clusters," but in the later editions of his books the word "galaxies" was substituted. Dr. Nichol's books became very popular, abetted by the fact that he was in close communication with Earl Lord Rosse, who—with his 3- and 6-foot reflectors—was presumably resolving many of the nebulae into stars—including the Orion nebula!

Meanwhile, the German astronomers had been using the term "*Weltinseln*," which appeared in Alexander von Humboldt's *Kosmos* (Vol. III, 1850). This term was translated literally by Otté (1851) as "world-islands." Somewhat before this, however, the American astronomer O. M. Mitchel, founder of the famous Cincinnati Observatory, had, in his contact with German astronomers, come across the word "*Weltinseln*." Using it as a basis, he provided the English language with the famous expression "island universes." This was the most popular nomenclature for a long time, although a battle raged among astronomers for nearly 80 years over the validity of the concept. Mitchel's use of the term appeared in 1848 in his "Planetary and Stellar Worlds." He was a great orator and his eloquence spilled over into his book. He introduces the island universes with the following rhetoric:

"We leave the shining millions of our own great cluster far behind . . . But now look forward.—A new universe, of astonishing grandeur, bursts on the sight . . . We have reached the clustering of ten millions of stars. Look to the right; there is no limit; —look to the left; there is no end. Above, below, sun rises upon sun, and system on system, in endless and immeasurable perspective. Here is a new universe, as magnificent, as glorious as our own,—a new Milky Way, whose vast diameter the flashing light would not cross in a thousand years. Nor is this a solitary object. Go out on a clear cold winter night, and reckon the stars which strew the heavens, and count their number, and for every single orb thus visible to the naked eye the telescope reveals a *universe*, far sunk in the depths of space, and scattered with vast profusion over the entire surface of the heavens."

Today, however, we employ the word "universe" for the all-inclusive system, the totality of all existing things; so the expression "island universe" has been used less and less frequently. We come across it primarily in its historical sense, as when one speaks of the "island universe theory."

"Island universe" was not the expression exclusively employed. For instance, the historian of 19th century astronomy, Agnes Clerke, wrote in 1905: "The question whether nebulae are external galaxies hardly any longer needs discussion. It has been answered by the progress of research. No competent thinker, with the whole of the available evidence before him, can now, it is safe to say, maintain any single nebula to be a star system of co-ordinate rank with the Milky Way."

Ironically, when — despite Miss Clerke's ultimatum—the validity of the galactic concept became evident, there were those who objected to the term "galaxy." The expression "extragalactic nebulae," mentioned by Dr. Edwin Hubble, came into temporary esteem because it was felt that "galaxy" was a word used so exclusively for our own Milky Way that it was not proper to use it otherwise!

UP TO WHAT DATE?

Scarcely a week passes in this rocketing, space-conscious age that old astronomical ideas are not being revised. Who can keep up with this trend?

Color photographs of the heavens that label as drab the brushes and palettes of artists accused in the past of having too colorful imaginations . . . artificial satellites and planetoids . . . rocket shots hitting the moon or going beyond it . . . photographic "shots" of the perpetually hidden face of the moon.

New detailed pictures of the never-hidden face of the sun . . . invisible messages radiated from space to tell new stories of the cosmic structure . . . colliding galaxies . . . new light on the seeable and unseeable . . . man and his instruments rising above the terrestrial mask.

Many opportunists rush to print with the "latest and most up-to-date" information available. But up to *what* date? What writer can be confident that his opus may not be out of date before his book can be published and that a sudden radio news bulletin may not render his manuscript obsolete as he types the final chapter?

As this is written comes the controversial announcement by Soviet scientist Fesenkov that the earth wags a 62,000-mile tail—caused, he hypothesizes, by the radiation pressure of the sun's light on our atmospheric debris, similar to the phenomenon responsible for the tails of comets. Dr. Otto Struve reports that the new National Radio Astronomy Observatory will soon be searching for signals from Tau Ceti and Epsilon Eridani, stars which appear to have constitutions not unlike that of our sun and which, therefore, may be hosts to planets . . . and possibly, planetary inhabitants.

What may develop between the moments that these words are written and the moment that they are read? This is the hazard that must be recognized by an author in the fields of astronomy, astrophysics, astronautics, or any of the other astro-sciences.

Nor is there any foreseeable end to this situation. Telescopes will be put into orbit, without men or with them. Man will build his space stations and observatories on the moon or on a counter-moon. But these are not ends in themselves. The achievement of these projects will but mark the beginning. The textbooks then to be written will join those of today and yesterday as reminders of the way in which the mind of Man still grows.

The one constant amid all this—invariable, eternal, universal—is the attitude of Man toward every challenge that space and time—infinite or infinitesimal—can possibly place before him. It is this inquisitiveness that knows no bounds, no limits of velocity or acceleration. It is this momentary drive that dictates Man's everlasting quest. Nor, in truth, is it fair to suggest that the attainment of research goals, milestone by milestone, will provide all the answers for which Man has been seeking or will seek in the future.

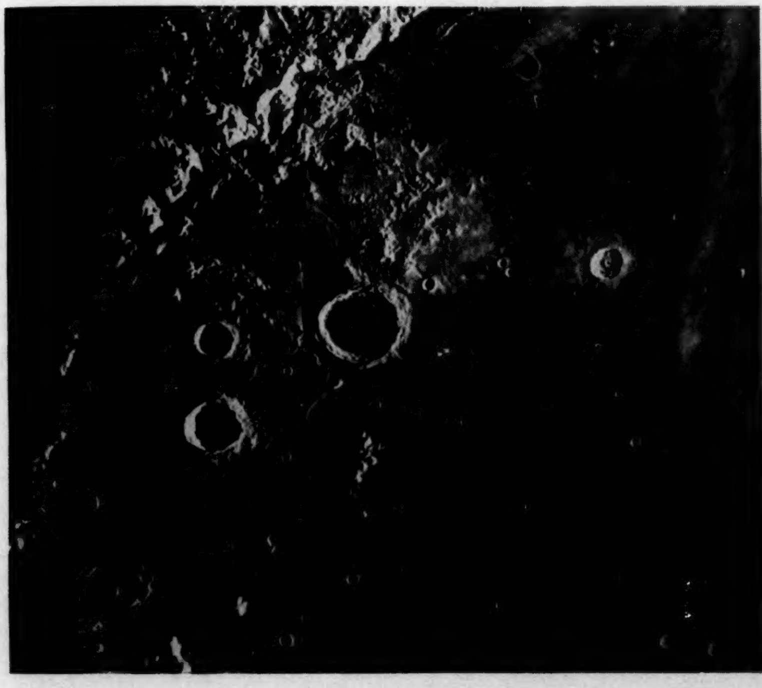
Yes, the moon has been targeted and its far side pictured. This is a step, not the end of a journey. Infinitely better pictures are available today of the familiar side of the moon, but ancient questions are still questions today . . . why . . . what . . . where . . . and how long.

Man will tread the surface of the moon and will pick up samples to bring back for study in earth laboratories, but this will not be an end to questions. Man has been living on the earth for a long time now, with an hospitable atmosphere, with communications and transportation and a growing array of research instruments and aids to interpretation. Yet, there are still quite a few basic questions about the earth which have not as yet been answered.

So will it be with Man and Space, forevermore. So long as this is true, Man will be Man. Should this ever cease to be true, neither heaven nor space nor science and its most sophisticated electronic brains will ever be able to help him.

This is when the final and incontrovertible textbook will be written. It will be both incontrovertible and final—and, we suggest, a bit dull in the reading.

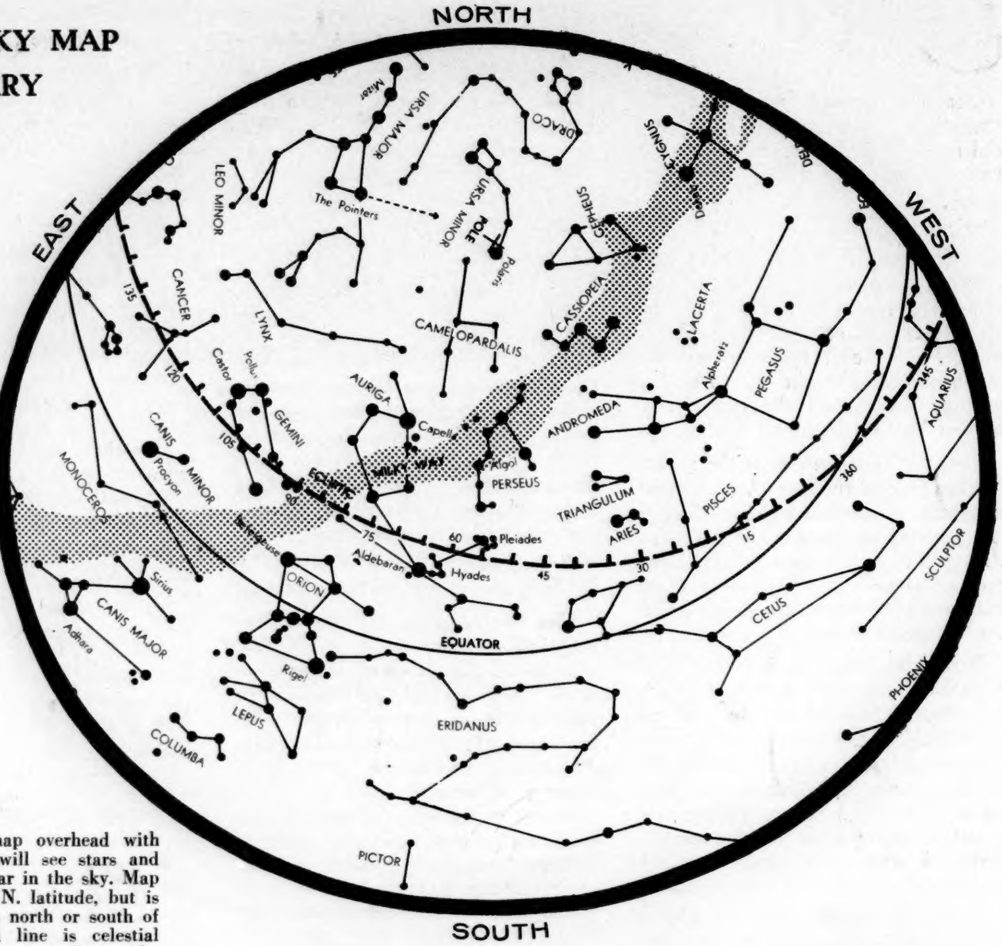
—A.N.S.



The region surrounding Archimedes, the large crater near center. According to tracking data, the Soviet lunar probe of Sept. 13, 1959, had its impact point between this crater and the two to the left, Autolycus (above) and Aristillus (below). The lunar Appenine range lies above, the towering peak of Piton near the bottom.

—Lick Observatory Photograph

EVENING SKY MAP FOR JANUARY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

9:00 P.M., Jan. 1 8:00 P.M., Jan. 15 7:00 P.M., Jan. 31

JANUARY AMONG THE PLANETS

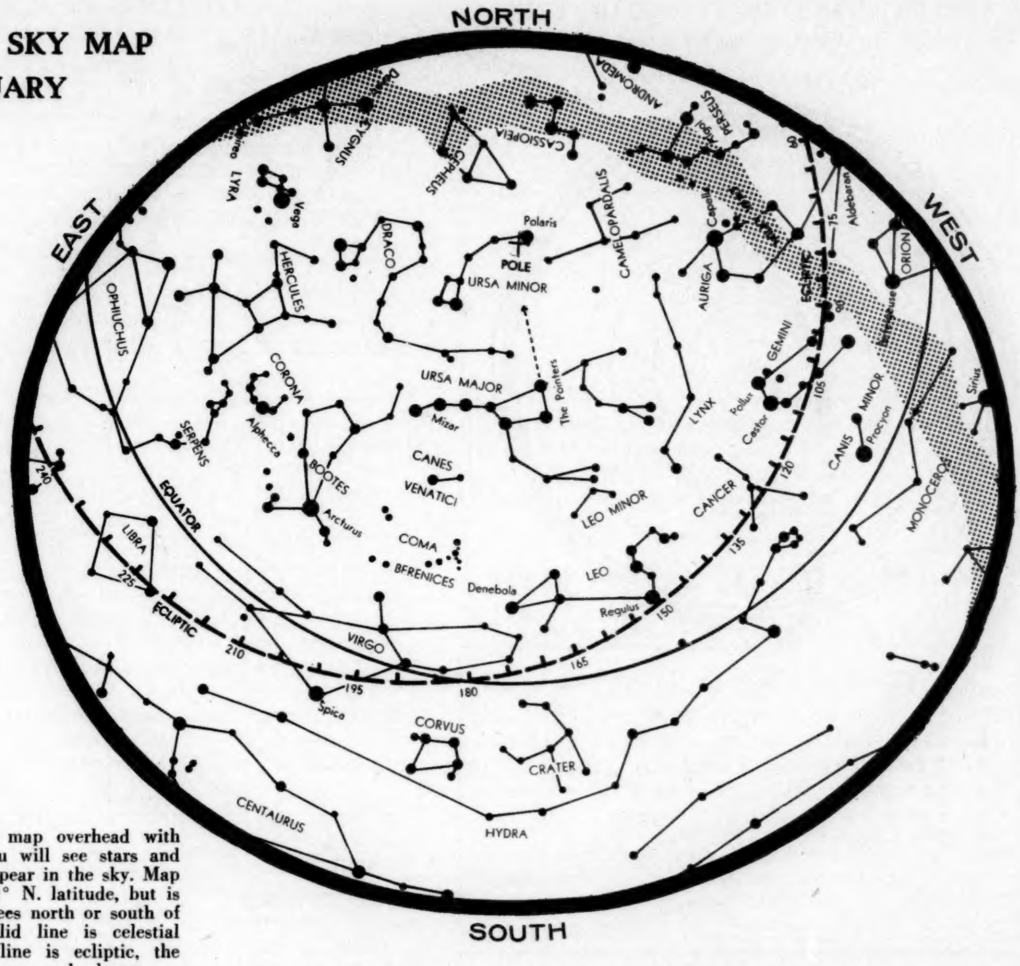
THE SUN: Just past the winter solstice, the sun has started its journey northward once again. Its eastward motion against the unseen star background carries it from Sagittarius into Capricornus. The earth is closest to the sun on Jan. 4, some 3,000,000 miles nearer than in July. This is a fact of small comfort, however, since the oblique angle of the sun's rays in the north temperate zone does not allow us to derive much benefit from our neighbor.

THE MOON: (See Astronomical Calendar for phases, conjunctions, etc.) As the January Calendar shows, bright Aldebaran passes less than a degree south of the moon on the morning of Jan. 10—for a viewer who happens to be observing from the *center* of the earth. However, for observers in the Middle West, in the Northwest, and in western Canada, Aldebaran will be occulted by the 11-day-old moon. Disappearance will occur in the morning hours of Jan. 10, between 09h and 10h Universal Time, (or between 3:00 a.m. and 4:00 a.m. CST). Reappearance will occur a bit less than an hour later for viewers in northwestern America. This is the first of a series of occultations of Aldebaran which will occur during 1960.

MERCURY: Already past western elongation, Mercury is too close to the sun for easy visibility. Aphelion occurs on the 9th, and it reaches superior conjunction with the sun on Jan. 26. Moves through Scorpius and Sagittarius and into Capricornus during the month.

VENUS: Still shining brightly at magnitude –3.6, but moving slowly toward its rendezvous with the sun. Mean elongation west during January is 39°; its phase is gibbous. In Scorpius early in the month, in Sagittarius at the end.

MORNING SKY MAP FOR JANUARY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

5:00 A.M., Jan. 1 4:00 A.M., Jan. 15 3:00 A.M., Jan. 31

JANUARY AMONG THE PLANETS

Mars: Past conjunction, Mars is beginning its move away from the sun and toward opposition late this year. Its mean brightness during January is just 1.6, hardly making it a conspicuous object in the Scorpius-Sagittarius region.

Jupiter: In Scorpius and brightening—past conjunction and now is –1.4. Equatorial diameter reaches 33″ of arc by the end of January. Jupiter and Venus rise in close (1°) conjunction before dawn on the 12th.

(See diagram on next page for configurations of its satellites.)

Saturn: In Sagittarius and brightening to 0.7 by the end of the month. Its rings cover nearly 35″ of arc, and their northern face is presented to the earth at a 25° angle.

Uranus: In Leo still, at right ascension 9h 30m and declination 15° 30′ north. Opposition next month.

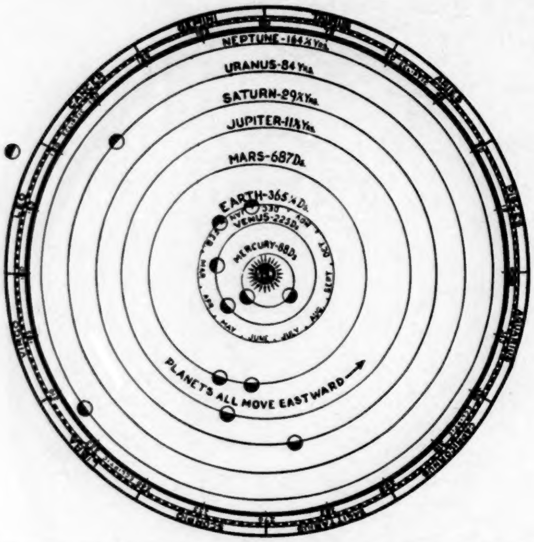
Neptune: Moving slowly along the ecliptic in Ophiuchus, a morning object keeping company with the other planets. (See page 11.)

EQUATORIAL STRIP CHARTS

The equatorial strip charts, showing the positions of the planets, sun and moon along with ecliptic, are being redesigned to include other sky objects of interest. Their publication in new form will be resumed beginning with the March-April issue.

HELIOCENTRIC POSITIONS OF THE PLANETS, JANUARY

(See Page 16 for explanation)



SYMBOLS USED IN CALENDAR

☉	Sun	♂	Mars
●	New moon	♃	Jupiter
☽	First quarter	♄	Saturn
☾	Last quarter	♅	Uranus
🌕	Full moon	♆	Neptune
☾	Moon generally	♇	Pluto
☿	Mercury	☌	Conjunction
♀	Venus	☍	Opposition
♁	Earth	□	Quadrature

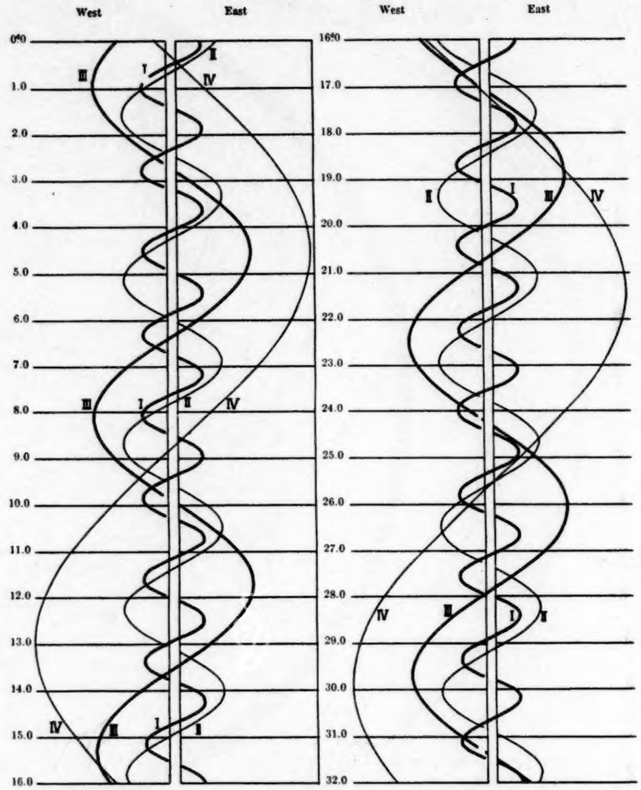
ASTRONOMICAL CALENDAR

1960 JANUARY Time: Eastern Standard

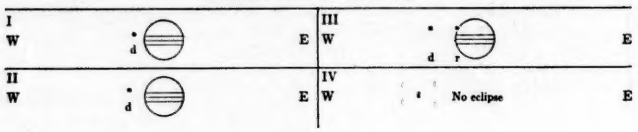
Day	Time	
4 Monday		⊕ at Perihelion
5 Tuesday	14h	☽ First Quarter
8 Friday	23h	♀ 7° north of *Antares*
9 Saturday	—	☿ in Aphelion
10 Sunday	04h	Occultation of *Aldebaran*, 0°.7 south of ☾
	08h	☾ at Apogee
	23h	☌ ☿ ♄ ☿ 1°.8 south
13 Wednesday	19h	🌕 Full Moon
16 Saturday	02h	☌ ♅ ☾ ♅ 4° north
21 Thursday	06h	☌ ♀ ♃ ♀ 1°.1 north
	10h	☾ Last Quarter
22 Friday	00h	☌ ♆ ☾ ♆ 2° south
25 Monday	03h	☌ ♃ ☾ ♃ 5° south
	10h	☌ ♀ ☾ ♀ 4° south
26 Tuesday	04h	☌ ♂ ☾ ♂ 6° south
	05h	☾ at Perigee
	10h	☌ ♄ ☾ ♄ 4° south
	10h	☍ ☿ ☉ Superior
28 Thursday	01h	● New Moon
31 Sunday	06h	☌ ♂ ♄ ♂ 1°.2 south

SATELLITES OF JUPITER JANUARY, 1960

(Universal Time)



PHASES OF THE ECLIPSES



EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

METEOR FRAGMENTS

The first half of the year is always much poorer than the latter half. The cause of this, according to J. G. Porter in his *Comets and Meteor Streams,* lies in the motion of the earth. More meteors will be seen when the apex of the earth's way is high in the sky rather than low. The apex is the point in the sky toward which the earth is moving at the moment, and, because this is on the ecliptic and therefore high in the sky in the early morning hours in autumn, the greatest meteoric rates occur then.

The only worthy shower during these two months is that of the Quadrantids, which emanates from a point in the now obsolete constellation of Quadrans Muralis; that point is now in northeastern Bootes. The radiant, or point from which these meteors appear to originate, is half way between the end of the handle of the Big Dipper and the head of Draco. The maximum may be expected on January 3rd or 4th, and since it is quite sharp, it could easily miss the more favorable after-midnight hours for any particular longitude. The maximum rate may be as high as 35 or 40 meteors per hour per observer if sky conditions are good. Many meteor showers originate from the debris of disintegrated comets, but there is no *known* cometary association for this shower, although a doubtful relationship may exist with comet Kozik-Peltier, 1939a, according to A. C. B. Lovell.

The scarcity of meteors during most of this period should not discourage the observer—rather, it should encourage him to give more of his time, because, more than likely, fewer observers will be on the job. The American Meteor Society would like to have hourly counts of meteors made at any part of the night, on any date of the year. Many more observing members are needed even to approach a good start toward this goal.

In this connection, *Sky Map* readers who would like to observe meteors on a serious basis are urged to write either Dr. Charles P. Olivier, president of the American Meteor Society, at 521 N. Wynnewood Ave., Narberth, Pa., or, if in the Missouri-Southern Illinois region, to contact the writer at 508 Marshall Ave., Webster Groves 19, Mo. All requests for information and instructions will be answered immediately.

EDWIN E. FRITON,
Regional Director,
American Meteor Society.

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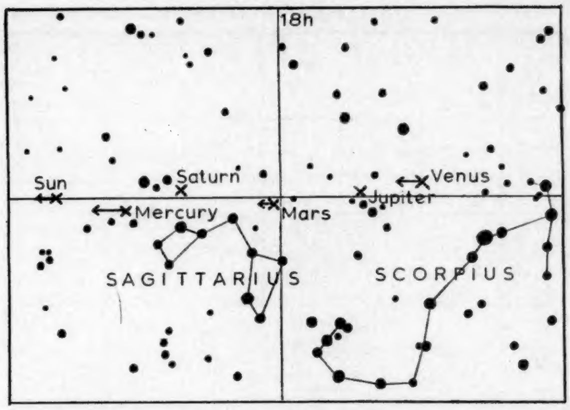


Chart shows region of Sagittarius and Scorpius, the X's indicating the sun and planets and the arrows any apparent motion during the Jan. 15-17 period. The straight line through the center of the chart is the ecliptic.

GROUPING OF MAJOR PLANETS IN JANUARY

Those who must bestir themselves at dawn in midwinter, and others who will make the effort to rise before the sun, will be treated to an unusual planetary show in mid-January. The five brightest planets will be in the southeastern sky before sunrise.

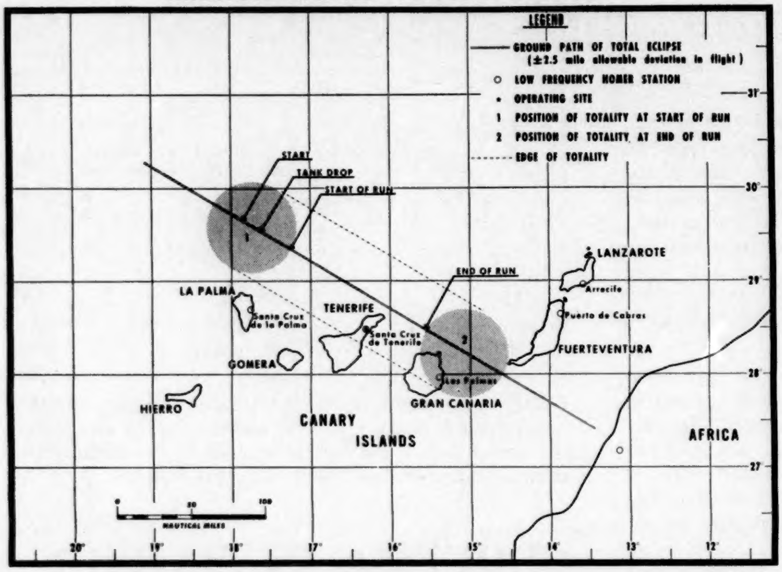
Venus, at this time between Scorpius and Sagittarius leads the parade, followed by Jupiter, Mars, Saturn and Mercury in that order. The sun, only a few degrees to the east of Mercury, spoils the show by blotting out Saturn and Mercury as they rise. Jupiter and Venus should be seen easily, and Mars for a short time very low in the sky. The situation on January 15 and 17 is depicted in the map. The respective positions of the planets and sun are shown for January 15, and the apparent motions of Mercury, Mars, Venus and sun during the next two days are indicated by the arrows.

By comparing this map with the charts elsewhere on these pages showing the heliocentric positions of the planets, one can visualize the relative locations, apparent and real, and their movements during this period. It will be noted, for instance, that as Venus moves into the region, Mercury, now past western elongation, moves toward superior conjunction with the sun, thereby fading from the scene. This pattern of the planets causes the rapid series of conjunctions of the moon with planets occurring on January 25-26 and February 21-27.

It is only a short span of two or three years out of twenty that such an act can be played on the celestial stage. Saturn and Jupiter come to conjunction but once in about twenty years, and it is only near such times that these giant planets are seen near together. The next time, the planets will hold their rendezvous after Saturn has travelled two-thirds of the way around the zodiac.

—S. O'B.

MISSION PROFILE "PROJECT ECLIPSE"



The map shows the Canary Islands and the flight path of the McDonnell Aircraft-U. S. Air Force eclipse expedition. Dotted line marks path of Voodoo jet as it stretched time of totality to nearly seven minutes.

—Courtesy of McDonnell Aircraft Corp.-USAFARDC

OCTOBER SOLAR ECLIPSE FROM THE AIR

John R. Hereford

McDonnell Aircraft Corp.

The total solar eclipse of Oct. 2, 1959, was the subject of three airborne scientific projects carried out from a McDonnell F-101B Voodoo jet. Three telescopes were mounted in the aircraft: (1) to measure the polarization of the sun's coronal light; (2) another to accomplish the same measurements using a photographic plate; and (3) a third instrument to make color photographs of the corona during totality.

The McDonnell Aircraft Corp.-USAF Air Research and Development Command expedition was based on the island of Tenerife in the Canary Island group, where a small landing strip was available. The Canary Islands lie in the North Atlantic Ocean just off the coast of western Africa and were ideally situated both geographically and climatologically for the eclipse. Equipment and supplies to support the airborne expedition were flown into Tenerife by the United States Air Force several days before the eclipse.

We arrived at the small airport early on the morning of the eclipse and made our last-minute checks of all equipment. The day was rather dreary, with middle broken clouds and a high overcast. Take-off was at 10:45 Universal Time (5:45 a.m., EST), and we headed to our rendezvous point over the island of La Palma, where we joined a B-47 bomber which was to serve as our starting-point marker. Leaving the B-47 at 30,000 feet along the eclipse path, we dropped our empty external fuel tanks, accelerated to a speed of approximately 1,000 m.p.h., and began our climb to 45,000 feet.

By this time, the eclipse was already 90% total and we had been observing it through crossed Polaroid filters intermittently whenever breaks in the overcast would permit. Then, at 32,000 feet, the clouds suddenly fell away below us and we had an unobstructed view of the eclipse, which was very near totality now. I took a moment to look ahead and slightly to the left where Fuerteventura Island lay under the overcast, but I could not make out Punta Jandia, the point where the majority of the ground-based eclipse expeditions were established.

The instruments in our Voodoo jet had been set up shortly after take-off, so all was in readiness for the starting signal—except for the final aiming. I attempted to bring the guide telescope into position on the nearly-eclipsed sun, but it wouldn't reach. The reason was soon obvious, and I asked Irv Burrows, the expedition pilot, how much of a crosswind we had—it was 65 knots, or nearly 75 m.p.h. Even at our supersonic speed this crosswind caused about 5° of crab angle in our flight attitude, which, as a result, used up all the steering freedom built into the telescope complex. I unbuckled my parachute harness and safety belts, moved to a perch on the edge of the seat, and finally was able to aim the telescope adequately.

Second contact—the beginning of totality—signaled the starting of cameras and recorders and then I was able to take a moment to look at the phenomenon above me. "Baily's beads," caused by last vestiges of the sun's light glimmering through indentations along the moon's limb, were bright and remarkably clear, but disappeared quickly. Then I looked down below us and saw a remarkable sight.

Fifteen to 20 thousand feet below on the smooth top of the overcast was the black, circular shadow of the moon, clearly set into the purple-gray of the cloud tops. I lingered a moment, hoping to spot shadow bands at the edge of the shadow, but the slight mottled texture of the cloud deck prevented any positive identification.

Returning to the eclipse, I began to search the corona for unusual features. The demarcation between the background sky and the outer corona was much sharper than in the other eclipse I had witnessed before; probably due to the lack of diffusing atmosphere at an altitude of nearly nine miles. The corona's limits of visibility ranged from a notch where the corona extended a scant half-solar-radius to a streamer which reached out to perhaps seven solar radii (over 3,000,000 miles).

Then, about two minutes after second contact, a magenta-colored flare appeared in about an eleven o'clock position. The color was of a fairly high saturation near the moon's

limb, but this faded to white two-thirds of the way out toward its extremity. However, the total extent of the flare was perhaps one solar radius (432,000 miles) before it finally blended with the corona. The flare's base extended for about 15° along the limb, and the flare itself showed no definite shape.

Finally, even the supersonic Voodoo jet lost its race with the moon's fleeting shadow, and 6m 51.7s after the beginning of totality Baily's beads once again burst forth from the limb and our mission was completed.

Mr. Hereford was the "man behind the cameras" in the racing Voodoo jet used on the McDonnell-USAF eclipse expedition. Also in the eclipse party as expedition meteorologist was Dr. E. M. Brooks of St. Louis University. His description of weather and ground activities follows at right.

ECLIPSE FROM THE GROUND

DR. EDWARD M. BROOKS

The McDonnell-USAF flight began northwest of Tenerife Island and ended above dense middle and high clouds between the islands of Gran Canaria and Fuerteventura. These clouds, reaching as high as 30,000 feet and extending from Tenerife eastward, prevented observations from a Heinkel III aircraft flying at 10,000 feet with some Spanish scientists.

Climatologically, such clouds are quite rare in the Canary Islands, which normally have only a low cloud sheet. However, on the day of the eclipse there were no low clouds. The flight also ran into abnormally strong southwest winds which were bringing in the clouds from the Cape Verde Island area in the tropics.

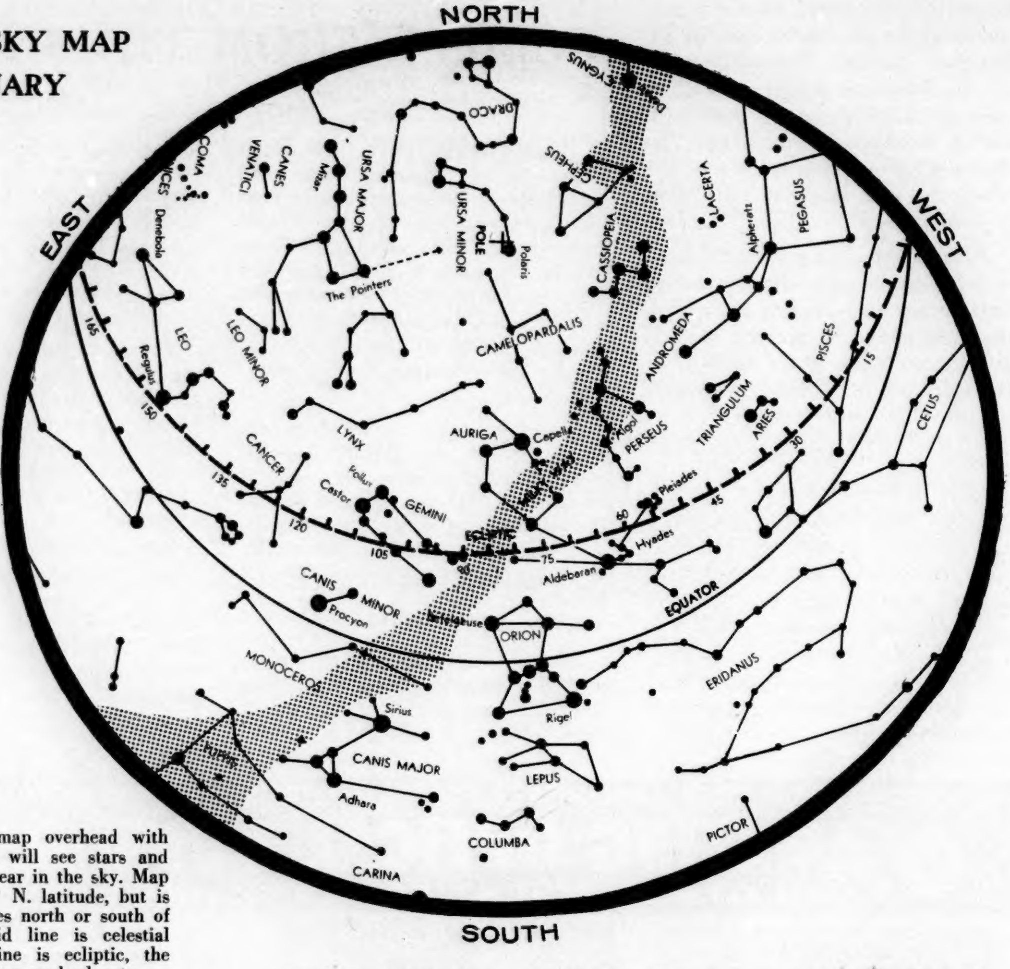
Aircraft observations were supplemented by ground observations where weather permitted. The author, as meteorologist for the McDonnell-USAF expedition, also participated in the operation by manning a battery-powered polarimeter at the Central Meteorological Office in Santa Cruz de Tenerife. Space for the installation of this instrument was provided by Enrique Cañadas, director of the observatory.

During the two minutes of totality, the solar corona was visible only for the first half-minute before it was blotted out by clouds. It was shaped like a dahlia and lacked the equatorial extensions which characterized the corona of the eclipse of June 30, 1954.

Because of the unusual southerly winds, the topographic influence on cloudiness reversed the Canary Islands' normal climatological situation, which is based on northerly winds. The north coasts of the islands, which were judged to be the

(Continued on Page 17)

EVENING SKY MAP FOR FEBRUARY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

9:00 P.M., Feb. 1 8:00 P.M., Feb. 15 7:00 P.M., Feb. 29

FEBRUARY AMONG THE PLANETS

THE SUN: The sun moves from Capricorn into Aquarius during February, passing northeast among the zodiacal stars.

THE MOON: (See Astronomical Calendar for phases, conjunctions, etc.)

MERCURY: Mercury races through Capricornus, Aquarius and into Pisces, reaching greatest eastern elongation on the 24th of February. It is at perihelion on the 22nd. This is not a favorable elongation, since Mercury is only 18° and low in the sky.

VENUS: Moves from Sagittarius into Capricornus during February, drawing closer to the sun and slowly fading to –3.4 at month's end, at which time it is only 30° west of the sun.

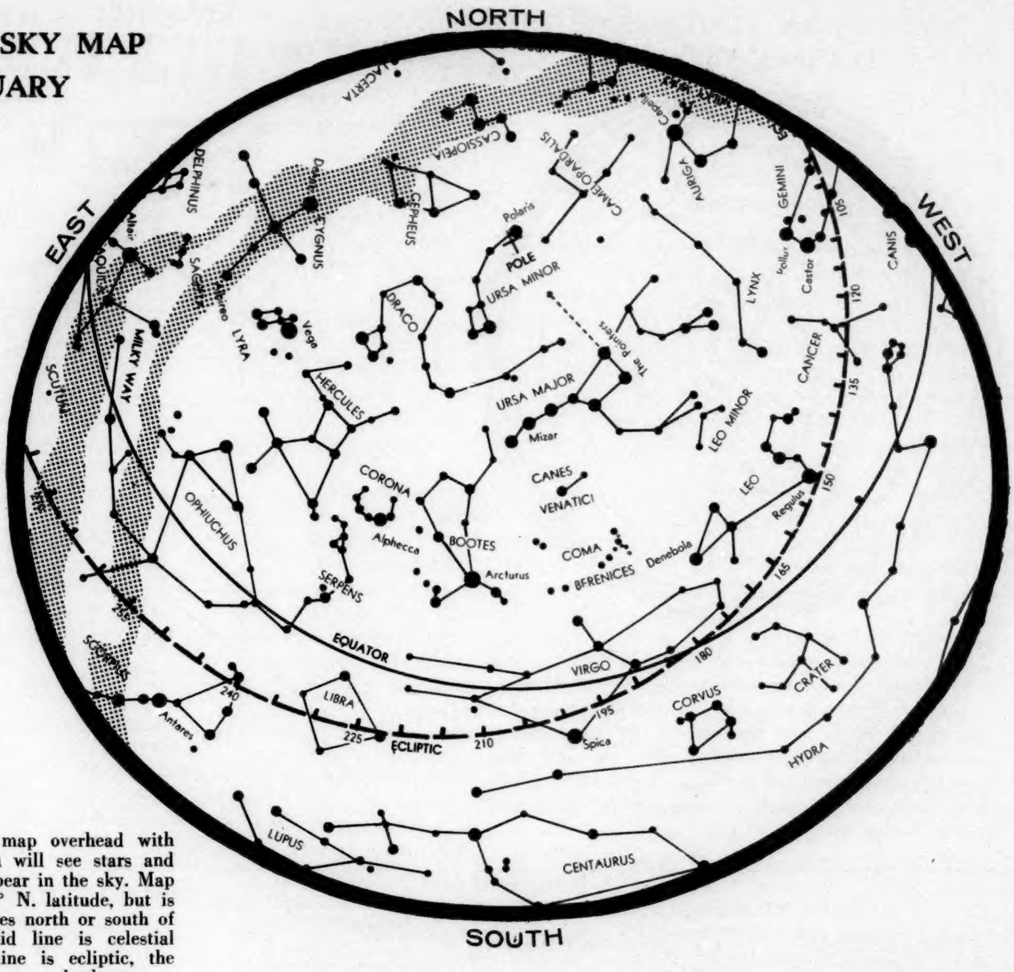
MARS: A 1st-magnitude object by the end of the month, Mars is slowly leaving the region of the sun and making its presence known in the dawn hours. Only shows a disk of 5″ of arc, and hardly worthy of telescopic attention.

JUPITER: In Scorpius, its equatorial disk grows to 35″ of arc and its brightness to –1.6 by the end of February. (See page 16 for configurations of its satellites.)

SATURN: Still in Sagittarius and steady at magnitude 0.8. A morning object, as are all the naked-eye planets.

URANUS: Uranus is in Virgo and at an opposition brightness of 5.7—a naked-eye conquest for clear eyes and clear skies. Opposition occurs on Feb. 8.

MORNING SKY MAP FOR FEBRUARY



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

5:00 A.M., Feb. 1 4:00 A.M., Feb. 15 3:00 A.M., Feb. 29

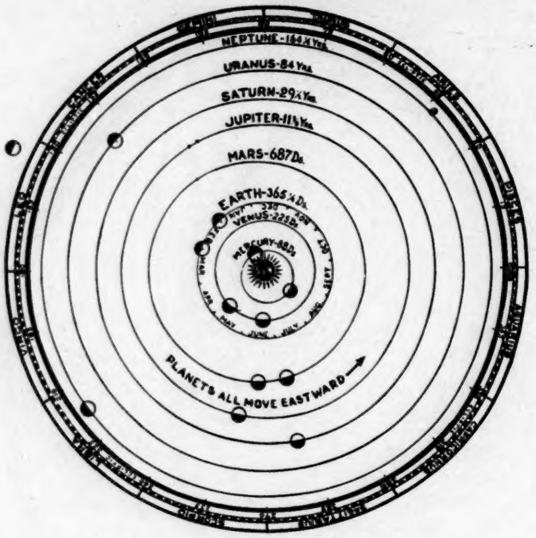
FEBRUARY AMONG THE PLANETS

Neptune: In Libra, an 8th-magnitude object of no special interest.

Pluto: Pluto is in opposition on February 24, just a few weeks more than 30 years since its discovery in 1930 by Clyde Tombaugh on plates taken at Lowell Observatory, Flagstaff, Arizona.

Pluto, however, is a 15th magnitude object. If you own an instrument large enough to see Pluto, you will know how to find it. It's in Leo, having traveled less than 60° since its discovery 30 years ago.

HELIOCENTRIC POSITIONS OF THE PLANETS, FEBRUARY



The solar system as it would appear if viewed from a point directly above (in relation to the plane of the ecliptic) the sun. Heliocentric positions are actually measured in degrees of longitude from the center of the sun. Owing to scale, orbits of outer planets do not reflect true size. Positions at beginning and end of month are indicated for Mercury, Venus, Earth, and Mars, the others for their mean position during month.

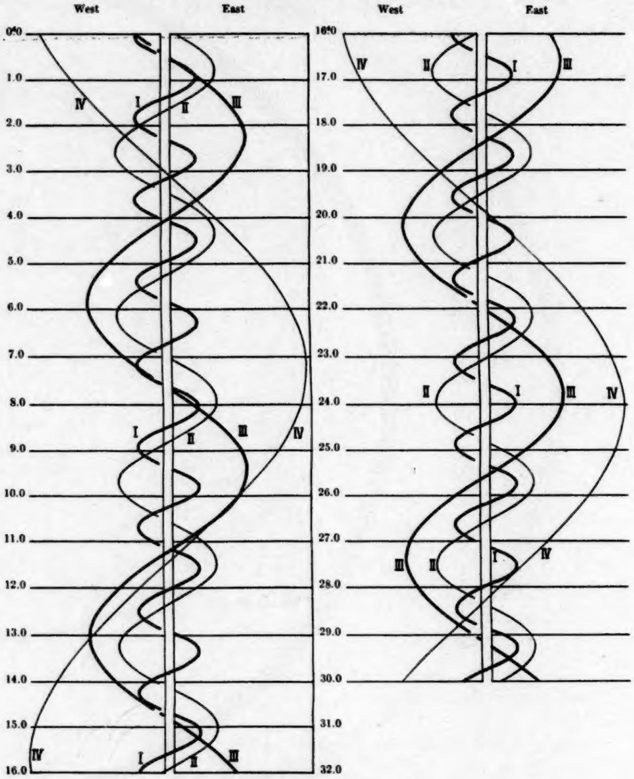
ASTRONOMICAL CALENDAR

1960 FEBRUARY Time: Eastern Standard

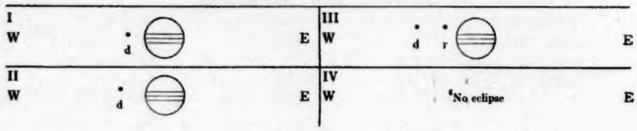
Day	Time	
4 Thursday	09h	☽ First Quarter
6 Saturday	11h	Occultation of *Aldebaran*, 0°.5 south of ☾
7 Sunday	01h	☾ at Apogee
	06h	☌ ♀ ♄ ♀ 0°.2 north
8 Monday	14h	☍ ♅ ☉
10 Wednesday	09h	♆ Stationary
12 Friday	07h	☌ ♅ ☾ ♅ 4° north
	12h	Full Moon
16 Tuesday	22h	☌ ♀ ♂ ♀ 1°.1 north
18 Thursday	—	☿ at ☊
	05h	☌ ♆ ☾ ♆ 2° south
19 Friday	19h	☾ Last Quarter
21 Sunday	—	♀ at ☋
	19h	☌ ♃ ☾ ♃ 5° south
22 Monday	—	☿ at Perihelion
	22h	☾ at Perigee
	23h	☌ ♄ ☾ ♄ 4° south
23 Tuesday	19h	☿ Greatest Elongation East, 18°.
24 Wednesday	02h	☌ ♂ ☾ ♂ 5° south
	08h	☌ ♀ ☾ ♀ 4° south
26 Friday	13h	● New Moon
27 Saturday	19h	☌ ☿ ☾ ☿ 3° north
28 Sunday	21h	☿ Stationary

SATELLITES OF JUPITER FEBRUARY, 1960

(Universal Time)



PHASES OF THE ECLIPSES



EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

YOUR TELESCOPE AND MINE

Thomas R. Cave, Jr.

The one great pitfall nearly all beginning mirror makers encounter is that of figuring—those last delicate touches that spell the difference between mediocrity and excellence. It is a fairly simple matter for the beginner to follow carefully clear instructions and successfully grind and polish his six- or eight-inch mirror. It's quite another thing, however, once the novice begins the tedious but vitally important figuring process. But actually, figuring is merely an extension of the polishing process, and, in a small mirror of normal focal ratio, it involves no mathematics.

Perhaps the primary reason for the beginner's figuring difficulties lies in a modified form of "buck fever." He spends many hours grinding his first mirror with loving care—running into a bad scratch more than once and regrinding, followed by several rather disastrous battles with the pitch lap. And finally, the long hours of polishing.

After all this preliminary work the average novice is more than ready to test the mirror a few times, perform a few more rounds of polishing and, as soon as the mirror begins to bear a family resemblance to the one in the book, he is ready to call it finished. But in fact, the experienced optician, amateur or professional, regards the grinding and polishing stages to be a routine mechanical procedure, and realizes that it is the *figuring* which demands and deserves his skilled attention.

There can be no doubt that the final parabolic figure is the all-important factor in determining the performance of any telescope mirror. A few scratches and pits on a mirror's surface, if the figure is truly excellent, will have no visible effect on the definition of the mounted mirror. True, the beginner's pride may suffer when he encounters scratches during the figuring of his first mirror, but he will do far better to proceed with accurate parabolizing than to fret over a few surface blemishes.

Many a worker will spend much needless time trying to remove a small central bump or depression, while in so doing he is turning down the edge of the mirror—literally "cutting off his bump to spite his edge!" The turned-down edge is certainly the most common defect in a novice's first attempt. *Small errors* in the 25% area near the mirror's edge affect performance far more greatly than *gross* errors near the center. Remember—a prism or flat of normal size masks off this center zone, and, even though the defect is larger than the flat, it will do comparatively little harm. Conversely, several concentric *outer* zones, even though slight in their departure from the acceptable figure, will tend to throw light everywhere except where it should be—at a sharp, well-defined point of focus. The diffraction pattern of a star under high magnification is still the acid test.

Most of the secret behind elimination of insurmountable obstacles in figuring lies in the pitch lap—the molded and faceted surface tool used in the final polishing and figuring processes. There are many types of pitch, optical and otherwise, on the market. The most popular has a coal-tar base, and, when tempered with a small amount of beeswax and pine tar, this works very well.

Probably the best available optical pitch is sold commercially under the name of "Zobel." Zobel pitch is used today by a large number of professional workers, and may be obtained from trade suppliers of optical abrasives and polishing agents in "hard" and "soft" tempers. The amateur should purchase about three times as much "soft" as "hard" Zobel pitch, and if he is working indoors at about 70°, this 3-1 ratio is exactly the proper mixture of the two tempers. Should the average working temperature be higher, use a little more hard pitch than in the normal proportion (the reverse being true *below* the 70° temperature).

A good rule for controlling the temper of any pitch (and of any mirror maker) is to make a new lap for every 5° of temperature change.

When using this pitch, it is a good idea to hand-polish several minutes and then cold-press, allowing the heat generated in polishing to dissipate. Trim or shave the facets of the lap frequently with a razor blade; this is particularly necessary during figuring.

Remember—during the polishing maintain a one-third diameter stroke (total length) with a one-sixth side stroke. Keep the lap facets well trimmed and by the time your first mirror is fully polished you will find it to be very nearly spherical and ready for figuring—the most important and telling of all mirror-making operations.

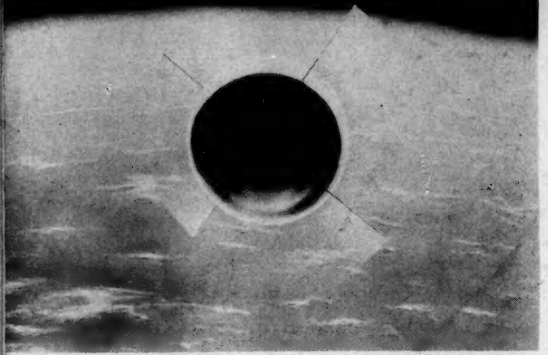
Eclipse From The Ground

(Continued from Page 13)

least favorable from a weather standpoint, proved to be the best locations to observe the eclipse. Individual observers on the north coasts of Tenerife and Gran Canaria (at Las Palmas) not only had excellent views of the solar corona but also saw shadow bands which moved in a southwest-to-northeast direction along the ground.

These observations suggest that the shadow bands are caused by atmospheric temperature variations moving with the wind, rather than by interference phenomena associated with the moon's limb, which was moving from the west-northwest.

Unfortunately, the climatologically favored south coast of Fuerteventura, where many of the astronomical expeditions were located, had a dense overcast and even rain during the eclipse. Although it was not possible to see the shadow bands or flash spectrum at Santa Cruz de Tenerife, the second and third contacts of the moon's limb with that of the sun could be measured approximately by the sudden changes in the darkness of the clouds. ●



Martin Aircraft Corp.

IN THE MOONWATCH ORBIT . . .

By Leon Campbell, Jr.

In this third year of the era of artificial earth satellites, the 5,000 visual observers who comprise the worldwide network of 200 Moonwatch stations continue to contribute significantly to man's growing knowledge of outer space. These laymen in the U. S. and 20 other countries, engaged in a volunteer program directed by the Smithsonian Astrophysical Observatory, had made nearly 11,000 observations of satellites—of more than 5000 transits—on the second anniversary last October 4th of the launching of the first satellite, Sputnik I. These data, essentially of the position, with time, of the satellite observations, have served mainly two useful scientific purposes. They have usually served to keep constant track of satellites, and have provided the basis for deducing new knowledge of the outer atmosphere.

Moonwatchers have demonstrated during these past two years that they can produce, on a frequent and regular basis, time-position data on virtually every satellite, the extremely faint not excluded.

This capability has not been attained easily. Before the first Sputnik was in orbit there were some widely-held notions and concepts as to what the problems of observing would be—and they appeared to be simple enough. Newton's laws of motion explained essentially the behavior to be expected of orbiting objects, and somehow the idea became rife that satellites would be highly polished, spherical objects which would appear as slow-moving, steady points of light—and that they would be about naked-eye brightness. Moreover, once the satellites were visually acquired, the Smithsonian's Baker-Nunn tracking cameras would lock onto them and never lose them.

Some Satellites Off-Schedule

The first satellites, being what they were, quickly changed some of this thinking. Newton's laws proved true enough, but satellites were whirling around in something less than a vacuum, and the variables caused by unpredictable and sudden solar activity made satellites—shall we say—misbehave. Moreover, many a satellite turned out to be not a sizeable, polished sphere, but a tube from a few feet to many feet long, and the reflected light fluctuated from bright to faint—or it faded out—or the object was so faint because of its small size that it was observable only in deep-penetration telescopes, and most Moonwatchers were not equipped with these. Even when the satellites were acquired, it was not always possible to keep the cameras photographing them. Sudden, unpredictable solar activity apparently caused satellites to accelerate without warning, throwing their celestial timetables so far off that the cameras could no longer locate them. Such a situation occurred last May, and during the summer it was necessary for Moonwatch to reacquire 1958 Epsilon not once, but twice. (But it was thereafter tracked almost to the end.)

Although Moonwatch has unique, dependable and extensive capabilities for acquiring newly-launched satellites, for providing useful scientific data by observing the dying phase of satellites, and for providing day-to-day tracking data that allow for continual up-dating of predictions, it has scored its most spectacular successes as a search organization. First it scoured the sky and discovered 1959 Alpha 2 (the carrier of Vanguard II) and later 1958 Beta 1 (the carrier of the grapefruit-size Vanguard I). In both cases these observations revealed that the instrumented satellites were separated while their carriers were still sputtering. However small the thrust, it was sufficient to cause the carriers to spurt out ahead of the payloads. This could well have brought about a "rear-end" collision, and, subsequently, changes were made in satellite separation techniques.

Scientific Value of Moonwatch

The great volume of Moonwatch observations in itself serves a specific, scientific use. An example is the study which Smithsonian astronomer L. G. Jacchia has made of the effect of solar (corpuscular) radiation in the upper atmosphere. These results depended greatly upon a large number of position data—running into the hundreds—and Moonwatch provided 70%.

There remains an unlimited challenge for Moonwatchers. For instance, they are capable of making photometric observations of satellites. These data should reveal what happens to the skin of an orbiting object, should give measures of wearing away (ablation) of the satellite and should provide measures of meteoritic impacts. From such light variations it will be possible to learn new facts about the earth's environment at and beyond the edges of the atmosphere.

But regular, day-to-day, basic observational data remain the prime purpose of Moonwatch. Especially, we need to keep track of the very faint satellites. Admittedly, the newer satellites may well be brighter, but some of the very faint ones now in orbit will not soon be gone. Indeed, the "grapefruit," according to preliminary minimum estimates, will be up 210 years, and its carrier 310! Obviously, we are just "first generation" Moonwatchers!

(Mr. Campbell is director of Operation Moonwatch stations for the Smithsonian Astrophysical Observatory, Cambridge, Mass. He will continue to be a regular contributor.)